AmerGen

Exelon SM

Nuclear

Oyster Creek Generating Station

REGULATORY CONFERENCE

September 27, 2004

Emergency Diesel Generator 1
Degraded Cooling Fan Event

AGENDA

- Objectives – *William Levis*
- Finding – *Bud Swenson*
- Diesel Testing and Results – *John A. Magee*
- Risk Assessment – *Michael P. Gallagher*
- Conclusion – *Bud Swenson*

Objectives

William Levis

Objectives

- Provide additional information addressing ability of Emergency Diesel Generator (EDG) 1 to perform its function.
- Provide clear and effective applicability analysis of Joliet Diesel Testing.
- Provide overall risk assessment of the significance of the event.

Finding

Bud Swenson

Finding

- Potentially Greater Than Green Finding - involving failure to follow written procedures to torque the cooling fan drive shaft bearing bolts following fan belt replacement for maintenance on EDG 1 during 24-month overhaul.

Resolution

- AmerGen agrees with Performance Deficiency.
- Root Cause – Human performance event involving the failure of plant personnel to follow the implementing procedure.
- AmerGen has taken extensive corrective actions to prevent recurrence.

Presentation Next Steps

- Diesel Testing & Results: John A. Magee
  - EDG 1 operation was degraded; however, the event did not involve a failure of the EDG.
  - Joliet Test was directly applicable to EDG 1 condition and provided conservative operating information.
  - EDG 1 was capable of performing its safety function for a portion of the mission time.
  - EDG 1 would have run a minimum of 6 hours and likely much longer.
- Risk Assessment: Michael P. Gallagher
  - The Risk Analysis demonstrates that the consequences of this Finding are of Very Low Safety Significance.

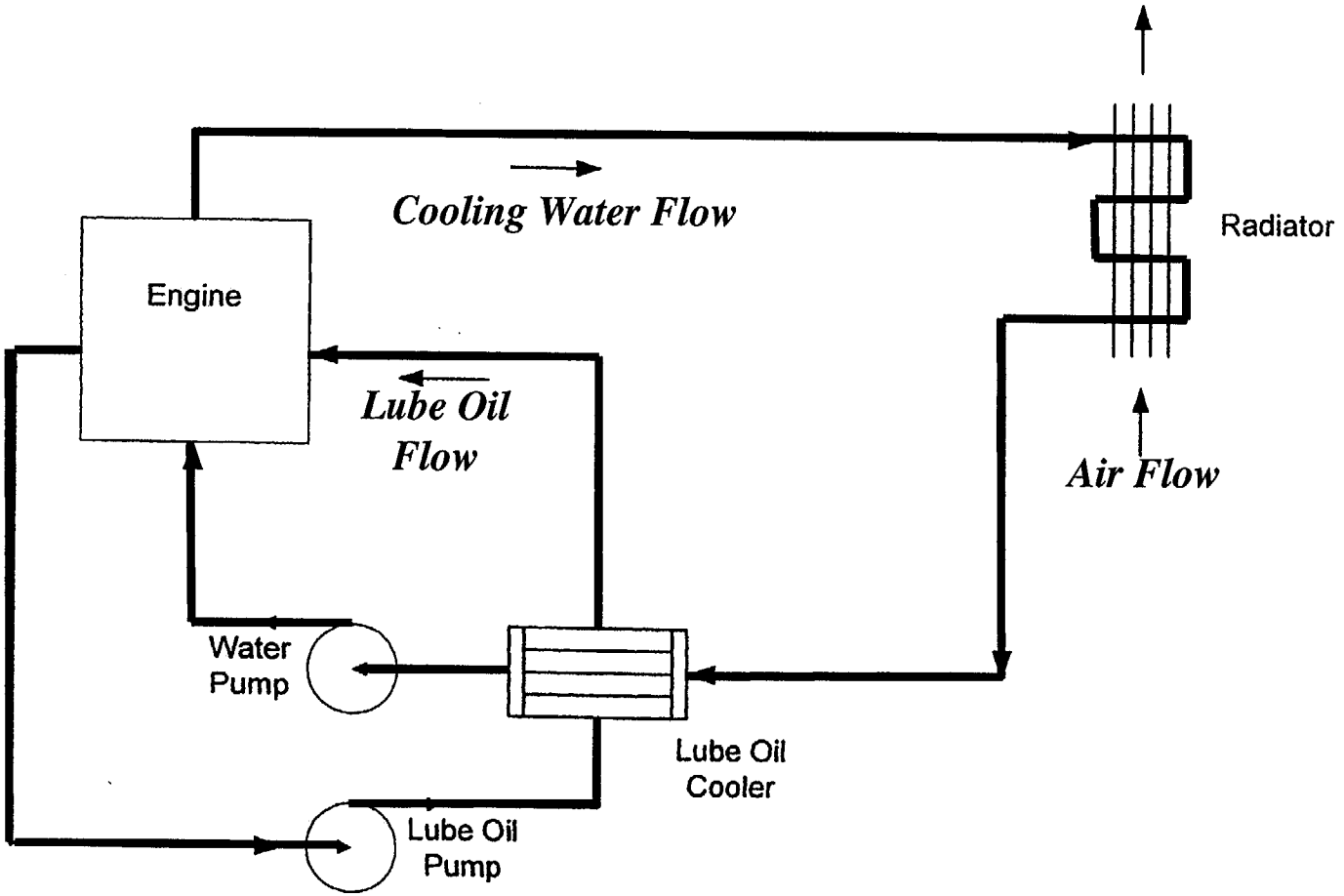
Diesel Testing and Results

John A. Magee

Diesel Testing Presentation Outline

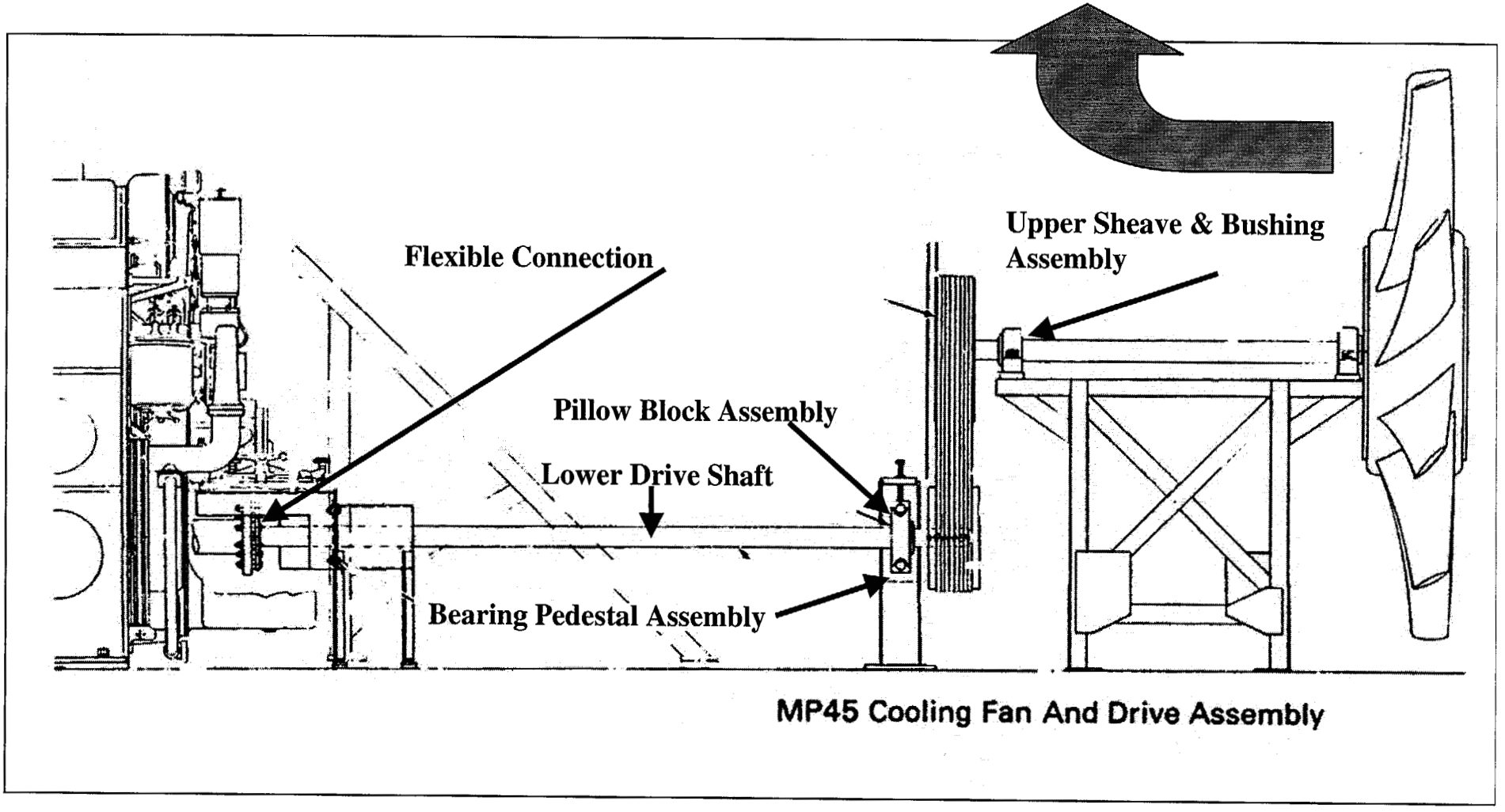
- Background
- Factual Observations
- Diesel Generator Fan Drive Test
- Key Similarities
  Test Diesel Generator versus Oyster Creek EDG
- Key Differences
  Test Diesel Generator versus Oyster Creek EDG
- Test Diesel Generator Results
- Analytical Results
- Conclusions

Air - Cooled Diesel Generator

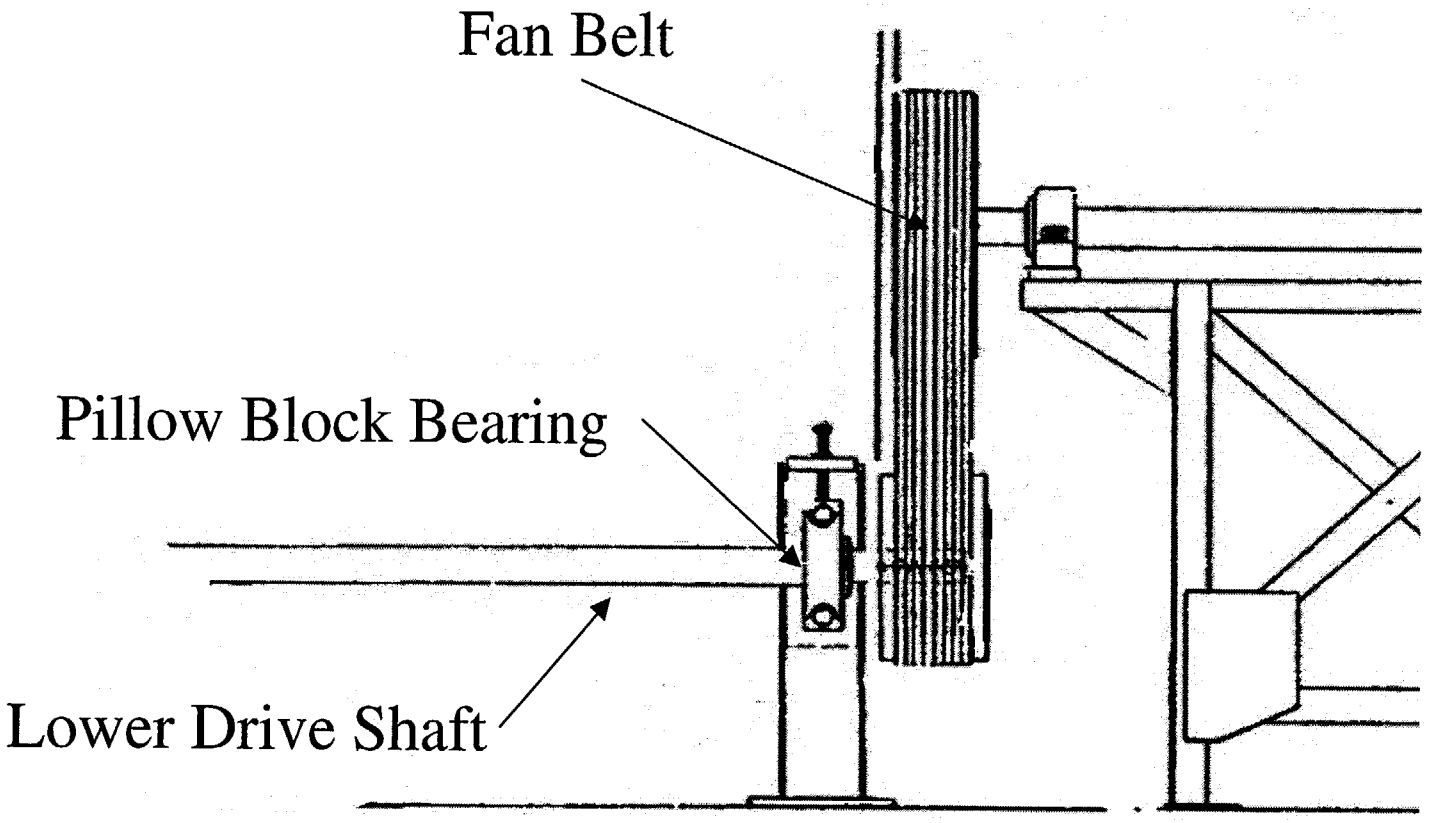


Radiator Cooling System for Oyster Creek EDG

General Arrangement of Diesel Generator



Close-up of Pillow Block Bearing Area



Factual Observations

- OC EDG 1 completed 24-month overhaul on 04/30/04.
  - Fan Belt Replacement was performed during overhaul.
- Multiple EDG runs were performed and EDG 1 was declared operable on 04/30/04.
- On 05/11/04, a surveillance load test was run for 1.5 hours with no problems noted.
- On 05/17/04, a surveillance load test was run for 1.5 hours.
  - This concluded in manual shutdown by operations, based on unusual noise and observed bearing movement.

Factual Observations

- OC EDG 1 continued to run until it was manually shutdown.
  - The OC EDG 1 did not fail to start or run.
- During this event Operations recorded all engine temperature parameters which were within normal range.
- Inspections of the EDG 1 revealed:
  - Pillow block bearing upper bolt loose and the lower bolt missing (later found on the floor)
  - No belt wear or damage observed (belt reused)
  - Bolts were not damaged
  - No damage to the pillow block bearing

OC EDG 1 Multiple Starts and Stops

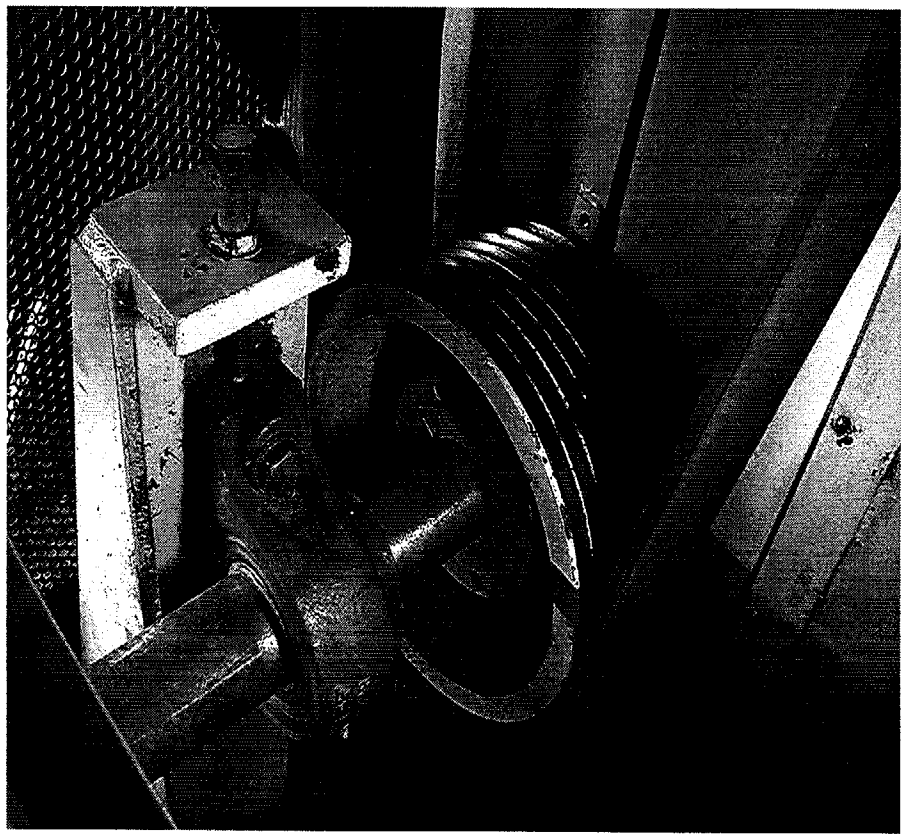
OC EDG 1 run times:

4/26/04 04:20 - EDG1 OOS for 24-month inspection	
4/29/04 06:13 - EDG1 started for idle run and testing	
4/29/04 08:11 - EDG1 idle run testing ended -	1:58 run time
4/29/04 22:43 - EDG1 idle start for testing	
4/29/04 22:57 - EDG1 idle run ended -	0:14 run time
4/29/04 23:28 - EDG1 fast start testing	
4/29/04 23:46 - EDG1 fast start ended -	0:17 run time
4/30/04 02:31 - EDG1 load test run	
4/30/04 03:00 - EDG1 load test run ended -	0:29 run time
4/30/04 03:01 - EDG1 load test run	
4/30/04 05:56 - EDG1 load test run ended -	2:55 run time
4/30/04 06:32 - EDG1 load test run from CR	
4/30/04 07:01 - EDG1 load test run ended -	0:29 run time
4/30/04 12:16 - EDG1 surveillance run	
4/30/04 13:36 - EDG1 surveillance run ended -	1:20 run time
5/11/04 01:19 - EDG1 surveillance run	
5/11/04 02:45 - EDG1 surveillance run ended -	1:26 run time
5/17/04 03:34 - EDG1 surveillance run	
5/17/04 04:57 - EDG1 surveillance run ended -	1:23 run time
5/17/04 17:50 - EDG1 Declared Available	
5/17/04 20:25 - EDG1 Declared Operable	

Diesel Generator Fan Drive Test

- Demonstrate operation of the fan drive in the as-found, degraded condition
  - –Fan drive shaft pillow block bearing support missing its lower bolt and a loosened upper bolt.
  - –Utilized an EMD MP36 DG at Joliet Station as test specimen because of the fan drive similarities to OC EDG 1.

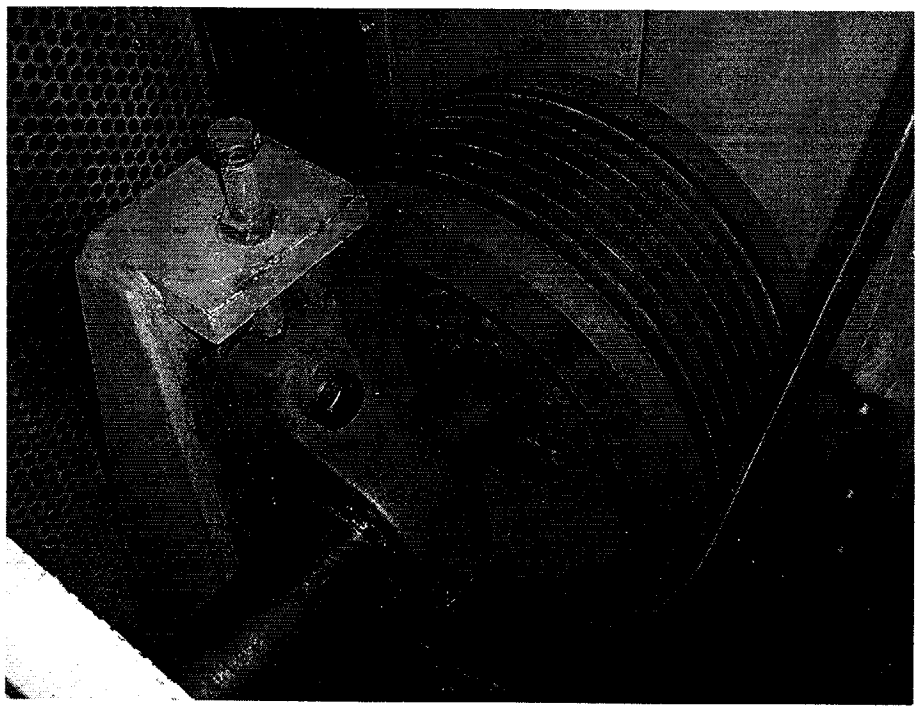
Comparison of Assemblies



← Test DG

Lower Drive Shaft Pillow Block Bearing,
Fan Belt and Sheave Assembly

OC EDG 1 →



Lower Drive Shaft Pillow Block Bearing,
Fan Belt and Sheave Assembly

Test Diesel Generator Results

1. Test DG ran for approximately 6 hours of operation.
2. Radiator fan operated at reduced speeds due to drive fan belt slippage.
3. High coolant temperature led to an automatic engine shutdown.
4. Demonstrated the Upper Pillow Block Bearing Bolt would not back out.

Key Similarities
Test DG versus Oyster Creek EDG

1. Identical Fan Design and Size.
2. Engine driven, lower fan shaft, speed (rpm's) are the same.
3. Identical OC EDG Fan Belt was installed on the Test DG to assure unit comparability.
4. Identical OC EDG Lower Drive Shaft and Pillow Block were installed on the Test DG to assure unit comparability.
5. The Bearing Bolts, removed from the OC EDG, were installed on the Test DG.

Key Differences
Test DG versus Oyster Creek EDG

1. Upper / Lower Sheave Sizes are different.
   - This results in a more conservative test.

2. Test DG trip logic was enabled.
   - The OC EDG 1 logic would have bypassed these protective trips (and others) for emergency starts.
   - This results in a more conservative test.

3. Fixed Air Flow vs. Modulating Fan Louvers
   - OC EDG 1 louvers lock full open > 200°F.

Additional Analysis

- Independent analysis was performed by MPR Associates, Diesel Generator Experts, of the degraded EDG 1 fan drive.

- Using the demonstrated pillow block movement of the test diesel, the EDG 1 belt slippage was calculated and subsequent reduction in air flow was modeled.

- This sensitivity analysis demonstrated that the EDG 1 belt slippage would be less than the Test DG; therefore, EDG 1 would have run cooler and longer.

- EDG 1 would have run a minimum of 6 hours and likely much longer.

Conclusions

- EDG 1 operation was degraded; however, the event did not involve a failure of the EDG.
- Test DG results are directly applicable to EDG 1 condition and provided conservative operating information.
  - Demonstrated the pillow block motion in the degraded state.
  - Demonstrated that the upper pillow block bearing bolt would not have backed out.
  - Sensitivity analysis demonstrated that the EDG 1 belt slippage would be less than the Test DG; therefore, EDG 1 would have run cooler and longer.
- EDG 1 was capable of performing its safety function for a portion of the mission time.
- EDG 1 would have run a minimum of 6 hours and likely much longer.

Presentation Next Steps

- Risk Assessment: Michael P. Gallagher
  - The Risk Analysis demonstrates that the consequences of this Finding are of Very Low Safety Significance.

Risk Assessment

Michael P. Gallagher

Risk Analysis Approach

- Conservative and Realistic
- Credits Actual Diesel Condition, i.e., Diesel was Degraded but not Failed
- Supported by precedent

Risk Analysis Approach
Dominant Core Damage Sequences

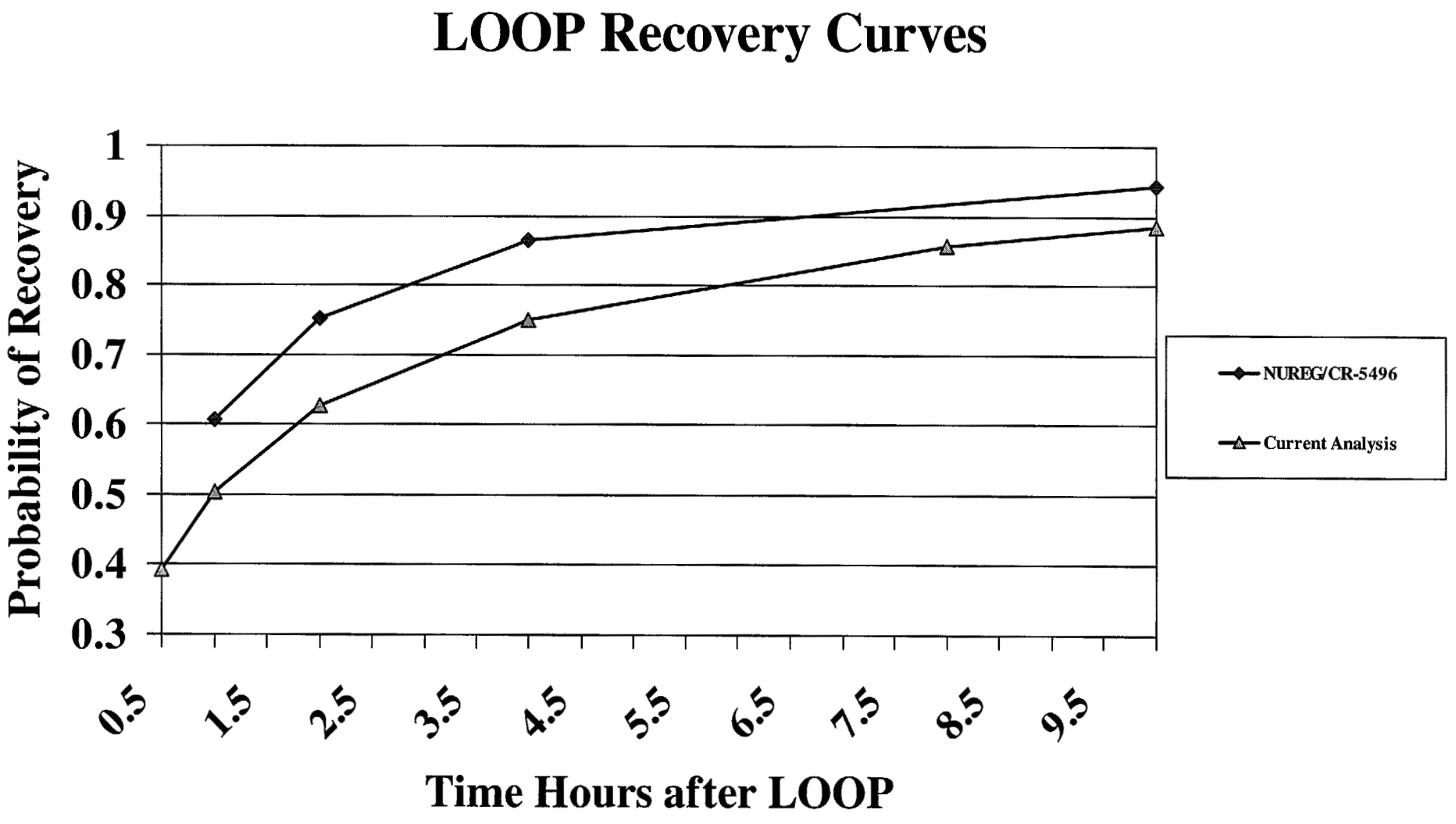
- Station Black-Out (Loss of All AC Power)
  - No Offsite Power Recovery at 8 Hours
- Station Black-Out (Loss of All AC Power)
  - Recirc Pump Seal LOCA
  - No Offsite Power Recovery at 1 Hour
- *Station Black-Out (Loss of All AC Power)
  - Stuck Open Relief Valve
  - No Offsite Power Recovery at 0.5 Hour
- Station Black-Out (Loss of All AC Power)
  - Isolation Condenser Make-Up Failure
  - No Offsite Power Recovery at 1 Hour

* SPAR sequence of interest from NRC preliminary analysis

Conservative and Realistic

- NUREG/CR-5496 LOOP Frequency of 0.046/year (consistent with NRC SPAR model).
- Loss of Offsite Power Recovery Curves Updated to include recent events (more conservative than NUREG/CR-5496).
- Utilizes full fault exposure of 17.5 days (consistent with NRC preliminary analysis).
- Recovery of EDG 2 Credited in SBO Scenarios (consistent with NRC SPAR model).
- Includes Best Estimate External Events Adder of 1.6E-7.

Conservative and Realistic



Conservative and Realistic

- Diesel maintenance unavailability conservatisms
  - OC PRA: 1.2% unavailability vs. OC actual performance: 0.5%
- Risk Analysis did not credit relief valve re-closure
  - 85% probability of relief valve re-closure could be utilized based on industry and plant specific data.
  - Risk analysis utilized stuck open relief valve probability of 9.16E-3 based on plant specific data.

Conservative and Realistic

- LERF Factor 0.1 justified based on Level 2 PRA analysis
- OC Basis:
  - Offsite Power Recovery before Vessel Breach supports "wet" drywell floor via Containment Spray
  - Offsite Power Recovery before Vessel Breach supports potential for In-Vessel Recovery
  - OC Mark I concrete curb minimizes potential for immediate drywell shell interactions (NRC Mark I Containment Performance Issue Evaluation)

Degraded Diesel Analysis

- EDG 1 did not fail to start and run.
- Conservatively credits 6 hours EDG run time, although EDG 1 would likely have run much longer.
- EDG 1 is assumed to start and run for 6 hours with weighted random failure probabilities included. Then assumes EDG 1 failed at 6 hours.
- Conservatively does not credit EDG 1 recovery.
- No common cause factor affecting redundant EDG was verified.
- Includes Two Fault Exposure Periods
  - 11.5 days from return-to-service to beginning of first surveillance test (credited 9 hours available run time)
  - 6 days from beginning of first surveillance test to end of second surveillance test (credited 6 hours available run time)

Precedent

- NRC risk significance determinations have accepted credit for the capability of a degraded component to perform its safety function for a portion of the mission time.

  - Susquehanna Station EDG Finding – IR # 2004-07
  - Cooper Station EDG Finding – IR # 2004-03
  - Surry Station EDG Finding – IR # 2001-06

Results

	Core Damage Frequency	Large Early Release Frequency
AmerGen Degraded Diesel Analysis – With Credit for 6 Hour Joliet Test	Internal = 5.0E-7 External = 1.6E-7 Total = 6.6E-7 Very Low Safety Significance	Internal* = 5.4E-8 External** = 1.6E-8 Total = 7.0E-8 Very Low Safety Significance
Green - White Threshold	1.0 E-6	1.0 E-7

*Based on Detailed Level II PRA

**Based on LERF Multiplier (0.1)

Sensitivity of Results

	Core Damage Frequency
AmerGen Degraded Diesel Analysis – With Credit for 6 Hour Joliet Test	Internal = 5.0E-7 External = 1.6E-7 Total = 6.6E-7 Very Low Safety Significance
AmerGen Degraded Diesel Analysis – With Credit for 9 Hour Run Time	Internal = 4.1E-7 External = 1.6E-7 Total = 5.7E-7 Very Low Safety Significance
AmerGen Degraded Diesel Analysis – With Credit for 12 Hour Run Time	Internal = 3.7E-7 External = 1.6E-7 Total = 5.3E-7 Very Low Safety Significance

Risk Analysis Conclusions

- AmerGen's Risk Analysis is appropriately conservative and realistic.
- AmerGen's Risk Analysis conservatively credited 6 hours EDG 1 run time, although the EDG would likely have run much longer.
- Precedent in risk significance determinations has credited the capability of a degraded EDG to perform its safety function for a portion of the mission time.
- The Risk Analysis demonstrates that the consequences of this Finding are of Very Low Safety Significance.

Conclusion

Bud Swenson

Conclusions

- AmerGen agrees with Performance Deficiency and has implemented extensive corrective actions.
- EDG 1 operation was degraded; however, the event did not involve a failure of the EDG.
- Joliet Test was directly applicable to EDG 1 condition and provided conservative operating information.
- EDG 1 was capable of performing its safety function for a portion of the mission time.
- EDG 1 would have run a minimum of 6 hours and likely much longer.
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